Intelligent Intravenous Infusion Pumps to Improve Medication Administration Safety

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Background. Intravenous (IV) medications are vital in the management of hospitalized patients. Inpatients frequently receive several IV medications concurrently, and these are commonly delivered with infusion pump systems. In particular, critically ill patients receive potent "high-alert" IV drugs, many with narrow safety margins requiring careful nursing titration. However, while intravenous medications have important benefits, errors associated with IV medication administration can result in severe or life-threatening adverse drug events (ADEs). Although errors in prescribing are often intercepted, administration errors do not get caught with most current systems While several safety improvements in IV infusion pump design have reduced mechanical complications, errors with IV drug administration such as incorrect programming persist. Intelligent IV infusion pumps have integrated software to provide point of care decision support (DS). This software includes drug library profiles configured for specific patient care units and includes programming of safety limits for drug/dose calculations.

Methods. We conducted a prospective, randomized study in an academic, tertiary care hospital to assess the impact of intelligent IV infusion pumps (ALARIS Medley pump) on the incidence and nature of medication errors and ADEs. Between February and December 2002, Medley pumps were used for all cardiac surgical patients. The cardiac surgical service drug library and DS was designed for the intensive care and step-down care units. The study compared pump use between intervention or "on" periods (DS with feedback during IV medication administration) and control or "off" periods. Feedback to nurses includes alerts, reminders, alarms and specific recommendations such as unit-specific drug rate limits. Two-week washout periods separated the 4 two-month study periods with DS alternating between "Off-On-Off-On" periods. The Medley software was downloaded to create log reports that captured all infusion pump actions or key presses and user interactions. Log reports were recorded during all study phases and than compared to chart review findings and physician medication orders. As a result of these comparisons, the IV pump software provided an unusual opportunity to learn new information about the processes of IV medication administration in general, and more specifically, unsafe IV practices.

Results. During the intervention periods, the DS intercepted many potentially harmful errors before reaching the patient. Several types of medication administration errors were identified. Unsafe IV practices included: failure to comply with standard IV drug dilutions; inappropriate use of the IV bolus technique (rates of 999 ml/hour for several minutes); use of potent IV medications, such as vasopressors and antiarrhythmics, without physician orders; overriding drug rate limits without supporting documentation such as clinical deterioration or critical changes in patient vital signs and incorrect programming of patient weights for medications with weight-based dosing protocols.

Discussion. Intelligent IV infusion pumps provide another technologic tool to complement computerized order entry and bar coding towards improving medication safety. Unsafe IV administration can be documented using intelligent IV infusion pumps, and therefore used to identify specific nursing practices that are amenable to correction with subsequent reductions of preventable ADEs. Monitoring infusion pump activity and repeated log report analysis can be used as part of a hospital's medication safety quality improvement program.

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